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ECONOMIES
IN
MAINTENANCE OF WAY.



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ECONOMIES

IN

MAINTENANCE OF WAY.

BY

BENJAMIN REECE, M. Am. Soc. C. E.

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ECONOMIES

IN

MAINTENANCE OF WAY.

The railway service can very properly be divided into two distinct classes, the one commercial, the other operative; the one secures the business from which the gross earnings are derived, the other performs the service for which the patrons pay. The one occupies the attitude of money getter, the other of money spender. But since the receipts are never

**Ry. Service
Classified.**

earned until the *service is performed*, it is self-evident that the net earnings of a Railway property depend as much upon the minimizing of expenditures as upon the enhancement of receipts. Proposed outlays for the development of new business should be as closely scrutinized as are those suggested for securing greater ultimate economy in operating the line. And original investments which promise a curtailment of expenditures should be as freely made as those which are expected to augment revenues.

**Earnings and
Expenditures.**

Since the net earnings of a line represent the gross receipts minus the expenditures, it is manifest that any increase on either side of the equation is equivalent to a decrease upon the other side, and conversely any decrease on the one side is just equal to a corresponding increase on the other. In effect, then, any additional cost of service corresponds to a diminution in earnings, while any reduction of expenses is equivalent to added revenues. A comprehensive and judicious recognition and acceptance of this principle is essential to evolution, while failing to observe, or continued neglect of it, ultimately results in dissolution.

The natural evolution of an economical and efficient service is towards increasing patronage, lower paying rates and growing prosperity. The logical sequence of inefficient service is expensive commercial methods, demoralized rates and eventual bankruptcy.

The brute force competition which develops in the capricious cutting of rates can be employed by all alike, by the weak and the strong, the poor and the well-to-do, and is only remotely affected by the character of the management. But the service which a line affords typifies its individuality and indicates the breadth and quality of the minds in charge; it further offers the basis of an enlightened competition which, while cheaply and satisfactorily serving the public, also gives returns to the owners of the property.

**Forms of
Competition.**

Since the indiscriminate cutting of rates comes within the power of all, it cannot be exercised exclusively to the advantage of any. Hence the power is voluntarily surrendered by every one, in order to control and regulate the actions of each, through the instrumentality of combines, pools or associations.

If in observing the readjustment of railroad properties we seek to discover those elements

**True Basis
of Economy.**

of fitness which are essential to survival, they will be found to reside in the low cost and the promptness of the service rendered, for the actual cost of the service will ultimately govern the rates which must be charged, while the value of any service is largely measured by its promptness and efficiency. It is true that these principles are vaguely and qualifiedly admitted, but they never have yet secured that complete recognition which must eventually lead to their acceptance as approved and necessary rules of conduct.

Without doubt vast sums of money have been unwisely expended for the extension of business, which when secured, gave no adequate returns for the effort, while even more has been lost by the withholding of expenditures which would have reduced the cost of transacting the business at hand. In the consideration of special outlays looking to ultimate economies, those promising the earlier results have unwisely been selected in preference to those of infinitely greater volume and importance, simply because the latter were a little more remote.

But many who would not lead have been

compelled to follow, in order to preserve their properties, and a marked advancement has been made in heavier and more powerful locomotives, as well as in the increased capacity of cars, yet in the aggregate but little attempt has been made to follow the same principles in dealing with our tracks, the general tendency to heavier rail sections being a notable exception, they being the main reliance, depended upon to arrest and correct the threatened failure of present methods and standard to meet the requirements of the increased and constantly increasing demands upon our tracks.

The roadway more than any other department requires methodical supervision, and systematized checks upon the men who are widely distributed over many miles of territory. The piece work system, so successfully followed in the shops, is impracticable for track work, because its quality is not apparent to the senses until weeks after its completion.

**Characteristics
of Track Work.**

The character of the train conductor's work appears daily on the train sheets and other office records. The performance of each engineer, with the quantity of waste, oil and fuel

consumed in doing it, is accurately noted for every trip. The station forces can be adjusted to existing exigencies, for as the above are all engaged in the direct conduct of transportation, each day's work is complete in itself, and has no direct bearing on the business of the future.

Of the mechanics engaged in the shops, and the men employed on the track, the very opposite may be stated, for their work is largely directed to making preparations for the future.

In the very nature of shop work, whether on cars or locomotives, it is, in the main, performed under the immediate supervision of the head of the department, who can direct methods and compel their application, whereas upon the tracks, with its scattered and oftime isolated forces, much of the work must of necessity be conducted by the section foremen in the absence of other supervision, direction or advice.

The maintenance of roadway and track is an occupation requiring strict attention to a multiplicity of simple and seemingly unimportant details, and calls for habits of close and accurate observation. Conditions arising

must be correctly discerned and analyzed, so the judgment will be prepared to successfully solve the problems so encountered. Such being the case, we determine by implication that in a greater or less degree each road possesses an individuality of its own, and is impressed with characteristics and conditions peculiar to itself. To thoroughly master the problems involved in the maintenance of any road, its special features must be studied until fully understood, and the proper remedies determined.

It is therefore evident that in the enumeration of economical methods in maintenance of way, I must measurably confine myself to such general propositions as will admit of well nigh universal application, and therein I will endeavor to simply indicate the direction and suggest the scope of the economies which lie within easy reach of those directing track expenditures.

Since quick delivery implies fast trains, that growing feature of transportation compels good track as a prime necessity, and since the cost of any service must ultimately govern rates, we can logically conclude that an economical and high order of maintenance

**Fast Service
Necessitates
Good Track.**

is essential to the survival of any line as an independent property.

Confining myself to the cross-tie system of track, which is in general use, and presuming that such an obvious necessity as perfect surface drainage is fully appreciated and provided for, we will seek to discover the best methods of maintaining our track at a minimum cost for labor.

**Stable Track
Secured
by Labor.**

The province of labor is to make the track stable, and to securely fasten and unite its parts so as to prevent independent motion. Elasticity of bearing does not imply loose and shifting parts, flexibility of material must not be confounded with yielding and inadequate support. The impact due to low joints, bad surface, poor line and defective gauge, greatly augments the destructive effects of increased wheel pressure, and the deterioration of track is much accelerated when deprived of proper care. This at once brings us to the quality of section labor, and the attention paid to details.

Eight years ago, in a paper read at one of the annual conventions of the American Society of Civil Engineers, I made the following observation:

**Importance
and Economy of
Thorough Work
and Attention
to Details.**

“In nothing do our track men need to be so fully drilled as in the matter of thorough and conscientious track work, particularly in tamping, to stand the service to which our tracks are subjected. To track foremen the condition of the track is largely a matter of appearance to the eye, and too frequently they are led into hurried styles of work, covering too much ground in a day, often impelled by the desire to make a better showing they are content to shovel tamp, or if bars or picks are used, the work is indifferently done, and although the track may be very pleasant to look at, in a few weeks at best the traffic or stormy weather destroys the surface and line, and the same track must again receive attention.”

What was important then, is even more so to-day, and subsequent experience as well as three years largely spent in examining the conditions and watching the varying methods on many lines, has amply verified and even emphasized the correctness of my deductions, and as a general proposition, I have found it to hold equally true on light traffic lines with small track forces, as it does on lines of heavy business and large section gangs.

**The Time to
Repair Track
Economically.**

It goes without saying that thorough work implies tight joints, the use of track level, true gauge, and conscientious tamping and attention to minor details whenever and wherever they are met. For the economical maintenance of track the section men should only be used as a skirmishing force to preserve the track when brought to high condition; for the work of general repairs or renewals they should never be so used, for the struggle will necessarily be on the defensive, with no chance for aggressive improvements.

When in the season for active repairs and renewals forces are kept so low that little or no advance can be made in improving the condition of the track, a large proportion of the men's time is spent upon the hand car, moving from place to place, as attention to the most urgent points may direct. It is unnecessary to say that the time so consumed in moving about is absolutely wasted, while in dodging about to repair the defects in the track due to former traffic, seeking to make it tolerable for current business, the entire amount expended becomes a tax upon money already earned, for labor so employed

makes no provision for the future, as it neglects the substantial repairs essential for the coming fall and winter's business.

As early in the spring as settled weather will permit, the section gangs should be increased to their maximum strength, and the work of renewals should be substantially completed by the end of June, when the forces can be very largely reduced. By beginning early, you have your pick of the best laborers, who later in the season are attracted to the harvest field, or municipal and miscellaneous construction work, in which rates of wages paid run higher than those offered to section labor. The early season, by reason of the moderate temperature, is far more favorable for hard, steady work, than are the hot, sultry days of mid-summer.

In any event, with track work as with any other, if you fail to push it, rest assured it will push you, and should it be delayed that long, the heavy fall traffic, not infrequently attended with unfavorable weather, will compel an increase of track forces at a time when from the nature of things the work must be hurriedly and incompletely done, in order to prepare for frost. Thus from year to year

the track lacks in stability, is shaky, and the parts being loose are permitted to move independently, so that the amount of labor required to keep such track in tolerable condition is in excess of the amount necessary when judiciously timed in thorough and systematic repairs.

**Advantages of
Concentrating
Forces Early in
the Season.**

When sufficient force is engaged early in the work of renewals, the men can proceed from point to point, completing everything as they go; 'tis true they may spend two days in going over the same ground that could be temporarily improved in one. In the first case, however, defects are not only corrected for the present, with little regard for permanence, but the track is as thoroughly tamped, tied and secured as the material at hand will permit, and with ordinary attention, should last the season out, whereas under the other system, the track being but temporarily repaired, periodical returns are necessary to preserve it in tolerable condition, and in the end three or four days' labor per year are spent in palliative measures, whereas two days' thorough work in the start would have sufficed for the year.

While recently comparing views with a rail-

**Showing
Practical
Results of
Thorough Work.**

way official of wide experience, who is recognized as a very competent director of track work, he told me that in 1886, when he assumed control of a part of one of our most important lines, the amount expended for track labor on the two principal divisions of the line amounted to \$200,000 annually, and the track then was only in that tolerable condition which the absence of system makes possible. The year following he increased the forces early, and insisted on thorough work. He was as watchful of those who attempted to do too much, as of those who failed to accomplish enough. The result of the season's work showed a marked general betterment of condition, the cost of labor for the year being reduced to \$163,000. The system was continued through 1888 with more marked improvements, at a cost of only \$139,000 for the year, since which time the divisions in question have been brought to a high standard of condition, at a yearly cost not exceeding \$120,000, or sixty per cent. of the amount formerly expended to secure a much lower standard of excellence, to say nothing of the fact that the demands upon the track are severer now than ever, not only as to traffic, but in

speed of trains, and weight of loads and motive power.

I know of a case where a line of moderate traffic and depleted exchequer permitted its track to fall into such condition that the State Commissioner of Railroads compelled them in places to reduce the speed of trains. After two or three experienced men had declined to take charge with the means at hand, a roadmaster of my acquaintance took hold. He was thoroughly imbued with, and had experienced, the value of thorough going work even on weak lines. It will be imagined that the track was in miserable condition, and the men were rushing here and there, to hurriedly improve the most serious places, which being inadequately remedied, would rapidly retrograde, so the men were never able to make satisfactory headway.

The first work of the new roadmaster was to send his men over their sections to shim the places that were badly out of surface. This was very quickly done, and at once afforded a short period of relief, which enabled him to thoroughly work some portion of each section. He continued this method to the end of the season, and the track passed into

winter in reasonably good shape for the traffic. The speed restrictions were withdrawn, and this was accomplished at less cost for labor than had been expended the year previous. The section foremen declared they had worked no harder, and could not understand why the results had been so marked in the face of decreased forces.

It has been my experience that, conditions being equal, the foreman having the best track calls for, or at least receives, the least material. This is particularly true on lines where for various reasons maintenance of way has been neglected. In the absence of proper instruction and direction the mechanical skill of an occasional section foreman will be noticeable by the strikingly superior condition of his track, and if you pursue the inquiry, you will generally find that he received the smallest amount of rail, on the score that he did not need it while being handicapped with a smaller force or longer section on the ground that he could properly care for it. I have a number of such cases in mind, and looking at the question in any light you please, I have no hesitation in saying that thorough track work is not only the most economical in the end, but it is

**Labor Properly
Directed
Saves Material.**

actually cheaper for the first, as well as succeeding years of its application.

**Relaying
New Rails.**

In no feature of track work are the evils of hurried and imperfect methods more conspicuously apparent, than where resorted to in the laying of new rails. In order to make a good showing, and to secure speedy, if only partial relief from the worn and loosely fastened rails which are being removed, miles of new rails are sometimes laid before the joints are properly put up and the new rails surfaced and lined. As a natural consequence, the new rail, in adjusting itself to its imperfect bearings, soon becomes surface kinked and bent, so as to ever afterward defy your attempts to make good track of it. Much extra labor will be required to keep the track in fair condition, and so far as labor is concerned, will afford but little advantage over the old rail removed.

To properly care for new rails so as to reap the advantage of their use, stretches only of such length should be laid as can be given immediate attention. Let a half mile be laid, and temporarily shimmed to surface as fast as the rail is laid, so as to protect it against the traffic of the day. When the half mile is

down, proceed from one end to remove the shims, and permanently perfect the surface, and line as you go. When completed, proceed with the second half mile, and so continue until the work is completed. The work will appear to be slower, some of the new rails will remain out of the track a few weeks longer, but by the close of the season the work of laying will have been better performed, the surface of the rail will have been preserved, and that at less cost for labor than the more impatient method, which leads to waste and ruin. How often do we hear demands for stiffer section rails, because the lighter sections have been wrecked from want of care and faulty laying, and while the heavier rail which replaces it may be a little better fitted to withstand misuse, it eventually succumbs to the same bad treatment, to be in its turn condemned.

Without doubt the increase of wheel pressure upon our rails calls for stiffer section rails, yet I have no hesitation in saying that heavy rails are often called for in order to correct defects entirely due to other causes.

Here is a rail of medium weight, showing no defects excepting at the joint; manifestly

**Stiff or Heavy
Section Rails
Do Not
Compensate
for Insufficient
Labor.**

a better fastening or more enlightened labor at the joint is rather needed than a heavier section rail which must in turn suffer from the same neglect. If the rail cuts into the tie, a wider based rail is demanded, while the tie could be more cheaply and more effectively protected by metal tie plates, especially designed for the purpose.

We have been inclined to look to the rail-maker to correct all the evils encountered in our road work, the head of the rail has been changed in form to afford a bearing for our joint fastenings, and its base has been increased in width to compensate for soft ties, and imperfect fastenings. These attempts to palliate evils which can only be cured by close attention and thorough work upon the track itself, have proved abortive, and while stiffer rail sections undoubtedly assist in the maintenance of stable track, yet they cannot be relied upon to take the place of well directed and conscientious track work.

Loose and churning track is largely due to careless methods and inefficient work. If such track is properly ditched and provided with a good bed of ballast, attention to the track fastenings, protection to the ties and

honest tamping will correct the evil. Should there be no ballast, it ought to be supplied. If the earnings will not warrant, or other outlays will not permit of the expenditure, the section of the roadbed should be trimmed down, so as to give a surface slope from the top of the ties at their center, to the bottom of the ties at their ends, thus allowing the water to run off freely from the surface, and providing for its escape from under the tie. If the diminished weight due to the reduced amount of earth about the ties, tends to an impairment of the line, or a transverse movement of the ties in the roadbed, in the direction of the creeping rails, additional weight can be secured by lengthening the ties, or the introduction of heavier section rails will decrease the tendency to creep as the undulations of the rail will be correspondingly reduced.

Those who are familiar with track work appreciate the fact that when rail is carefully spiked to new oak ties, and thoroughly tamped, but very little labor is required to preserve it until the ties begin to soften and cut in, then the undulations of the rail become more pronounced, the spikes pull and conditions of

**Labor of Repairs
Increase as
Ties Soften
from Age.**

instability arise, calling for greatly increased labor to correct. This at once suggests the use of metal tie plates which will afford flexible yet unyielding support to the rail, by which means so far as the rail bearing portions of the tie are concerned, the conditions of a new tie are preserved throughout its life. This not only minimizes the ordinary track labor but saves entirely the work of adzing down ties and restoring the rail to position, involving re-spiking, with the resultant injury to ties due to frequent spiking.

**Tie Plates
Preserve Ties
and Securely
Fastens the
Rail.**

As much labor is required to keep the track securely fastened down to gauge, so will much of that work be saved by the application of tie plates, which, while protecting the tie from being cut in, securely holds the track to gauge, and prevents the undulations due to cut ties and consequent lifting of spikes.

**Waste in
Tie Renewals.**

We will now pass to a consideration of the economies involved in the question of tie renewals. But few fully recognize and appreciate the growing importance of this enormous item of expense. A few years since the cost of tie renewals was but a fraction of the amount annually expended for rails, whereas to-day the figures are reversed, and the cost

of ties largely exceeds the amount spent for rails, and yet no single feature of present railroad practice affords the opportunities for such large reductions in expenses, as that of tie renewals.

From the pages of such State Railway Commissioner's reports as were within my reach, I have culled some interesting figures, which tell their own story and point their own moral. I made no selection of years or States, but took such as were accessible during the preparation of this paper. I will not read the figures in detail, but they can be examined if desired.

In the Michigan group, as in other States, I selected the lines showing gross earnings of a quarter of a million dollars and upward, which I need not say includes most lines outside of independent spurs, logging tracks, etc. The group mentioned includes such lines as the Lake Shore, Michigan Central, Northwestern, F. & P. M., C. & W. Mich., etc. In the report for 1881, the aggregate cost for ties is given as \$856,720, and for rails \$2,237,693. Ten years later, the report for 1891 shows the cost of ties to have increased to \$1,496,169, while the cost of rails had been

**Greatly Reduced
Cost of Rails
and Increased
Cost of Ties
Renewed on
Michigan Rail-
roads.**

reduced to \$975,461. From 39 per cent. of the cost of rails in 1881, the expenditure for ties had increased to 153 per cent. of the cost of rails in 1891.

**Greatly Reduced
Cost of Rails
and Increased
Cost of Ties
Renewed
on Wisconsin
Railroads.**

The Wisconsin group, including the C., M. & St. P., the C. & N.-W., Green Bay, etc., the amount for tie renewals, distributed under that head in 1879, amounted to \$349,126. The same lines reported the cost of rail renewals for the same year as being \$711,363. In 1890, ties are returned as costing \$2,167,276, the rails, \$940,494, the relative cost of ties to rail being 49 per cent. in 1879, 230 per cent. in 1890.

**Same for
Kansas.**

The Kansas group includes Santa Fe, M. P., U. P., R. I., M. K & T., K. C., Ft. S. & M., etc. The average of two years renewals, 1888 and 1889, charged ties with \$1,755,250, while for rails it was only \$794,222, the cost of ties being 222 per cent. that expended for rails.

**Same for
Connecticut.**

The Connecticut group includes the N. Y., N. H. & H., the N. Y. & N. E., and the N. Y., P. & B. From June 30, 1888, to June 30, 1890, these lines made an average annual expenditure of \$403,314 for ties, and \$154,501 for rails, the amount expended for the former being 261 per cent. that of the latter.

These figures indicate that from aggregating one-half of the expense for rails in 1881, the cost of ties increased to twice the amount paid for rails in 1891. Are we not here confronted with a condition which calls for our earnest consideration, and most careful analysis? When our rails are worn out and unfit for further use in the track, we can practically exchange the old for new at the rate of about five tons for three. When ties are removed from the roadbed, they can only be disposed of at the expense of further labor for collecting, piling, burning, etc.

The \$975,461 expended for rails in 1891 by the railways represented in the Michigan group, represents many consultations; from the consideration of the estimate to the laying of the rail, with little doubt it was made a matter of close inspection and mature deliberation, by those controlling the purse strings, no less than those in charge of maintenance. Every official, from the president of the line, down to the section foreman in charge, felt the responsibility of their judicious use, and those directing or those engaged in using them were held to strict accountability.

**Rail Renewals
Subject to
Constant
Supervision.**

**Tie Renewals
Inadequately
Supervised.**

But how with the \$1,496 169 expended for tie renewals during the corresponding season? Tell me, if you can, of any other line of business where the same amount of money is expended more loosely, and with fewer checks upon the men who have almost unrestricted disposal of material of such enormous value?

The nature of tie renewals does not permit of close and constant supervision, hence the greater necessity for the institution of checks upon the section foreman who determines upon the necessity for renewals, and upon whose judgment and conscientiousness largely depends the discrimination and economy with which renewals are made. I was early impressed with the importance of this question, and as far back as 1879, I investigated this question of tie renewals upon some nine hundred miles of line of which I was then in charge of the maintenance. I issued orders early in the season that all ties removed from the track should be conveniently piled and allowed to remain on the right of way until I examined them. During the season I made a hand-car trip of the line, inspected every pile of ties, and found a large number which had

been prematurely removed. The inspection of these ties served as object lessons to the foremen, and when their attention had been properly called to the subject in detail, and the figures of cost stated, for the first time they fully realized that two ties wasted was equivalent to the loss of a laborer's wages for the day. I called for a recount of ties to be put in for each mile of the line, and my exertions in this direction were rewarded by reducing the expense of tie renewals some 22 per cent., and ninety thousand ties were left over, for the succeeding year. That improper ties are not kept in the track is a matter for daily inspection; that good ties are not removed from the track requires constant vigilance and care, and I know of no better safeguard than an examination of the ties after removal, the same as indicated above.

In using blank statements, it is better the material used and labor performed should not appear together. This is particularly true of ties. The men gain an impression that as large an amount of material as possible should be shown as used for a given amount of labor. This leads to waste of material and inefficient work.

The foremen were an excellent body of men, fully as watchful as the average of their class, but their attention had never been properly directed to the subject, and in the absence of careful and specific instructions and supervision, they never realized the magnitude of the losses involved.

Tie Inspection. Another source of loss is frequently found in looseness of inspection, sometimes the result of carelessness, and sometimes intentional in order to keep down the increasing price of ties.

Cause of Failure in Ties and Economical Methods of Correction. Again, many ties are removed from the track because of the cutting in by rails. This is particularly the case with soft wood ties. Of course it is a question of tie and traffic and the heavy business of some lines leads to a similar failure of oak ties, particularly in yards, and on curves. This feature can be entirely corrected at moderate cost, for metal plates which will not only protect the ties from the cutting action of the rail, but when of proper form serve as improved rail fasteners, and secure great economies in labor. As to the proper form and uses of metal tie plates, I treated the subject quite fully in a contribution to the *Rail-Road Gazette*, which appeared

in issue of February 19, 1892, to which I would respectfully refer those who desire to investigate the question further.

Let your tie estimates show the number of ties to be renewed between the respective mile posts, and classify the cause of removal, so as to indicate the number to be renewed by reason of being cut in by rail flanges, because of being spike killed, and the number to be removed because of decay. This will enable you to keep a yearly record of each mile, while a comparison of the ties with the estimate affords data for a determination of the track man's judgment and enables you to correct any tendency to wastefulness. The classification of causes for their removal will enable you to determine as to what devices can be economically and effectually used.

**Suggestions
as to
Tie Estimates.**

The figures showing the cost of tie renewals further indicate that the subject of treated ties has with us never received the attention it deserves, and yet an abundance of experience as to methods, efficiency and cost is available for an intelligent investigation of the subject.

Inferentially, throughout my paper, it will **Resultant.**

be noted that much watchful labor is required to compensate for the use of imperfect fastenings, hence it may be relied upon that judicious outlays for improved fastenings, which perfect the union of rail and tie, will lead to great saving in the expense for labor, as well as marked improvement in the track. But the length of this paper has already exceeded the limits I had set, and I feel that even now I have trespassed on your patience.

If, then, I have correctly observed, and subjected my observations to an accurate analysis, it will appear evident that more thorough track work when timely applied, is the basis of economical track work, that stiffer rails and improved fastenings will reinforce the results of labor, but cannot be depended upon to take the place of enlightened supervision and conscientious work. That the increasing gravity of the tie question directly points to the necessity for stricter supervision of the process of renewals, and more careful inquiry as to the means of their preservation against abrasion and against decay.

When these questions shall have attracted the attention they deserve, and when they

shall be recognized as living, ever present facts, the way will have been prepared for a more permanent way, with lessened demands for material, and reduced expense for labor.

MICHIGAN GROUP.

NAME OF ROAD.	1881 REPORT.		1891 REPORT.	
	RAILS.	TIES.	RAILS.	TIES.
Grand Trunk.....	.....	Not	shown.	.....
C., D. & G. T. June.....	\$ 16,152	\$ 10,953	.....	\$ 5,331
C. & N.-Western.....	519,881	297,686	\$234,389	437,271
C. & W. Mich.....	147,183	19,277	15,721	43,480
D., G. H. & M.....	38,166	26,915	8,596	27,144
D., L. & N.....	80,064	20,000	366	26,384
F. & P. M.....	Included In	Rep.	.....	30,079
F. & W. & J.....	23,150	7,660	With Lake	Shore.
G. R. & Ind.....	157,437	27,122	8,188	47,691
L. S. & M. S. Ry.....	414,264	288,258	369,642	332,416
Mich. Central.....	594,596	135,687	186,961	200,174
W. St. L. & Pac.....	Construction.	.....	139,743	272,133
J. L. & Sag.....	226,915	21,360	Mich. Central.	.....
Detroit & Bay City.....	20,155	1,902	Mich. Central.	.....
Chicago, Wabash & Mich.....	.....	.....	7,125	21,058
D. S. S. & Atlantic.....	.....	.....	2,122	16,070
Mil. & Northern.....	.....	.....	2,618	17,400
T. A. A. & N. M.....	.....	.....	.....	19,539
	\$2,237,963	\$856,720	\$975,461	\$1,496,169

1881=Ties, 39 per cent. of the cost of rails. 1891=Ties, 153 per cent. of the cost of rails.

CONNECTICUT ROADS.

Average for two years, from June 30, 1888, to June 30, 1890, from reports of
Railroad Commissioner.

NAME OF ROAD.	RAILS.	TIES.
Housatonic.....	\$ 3,744	\$ 37,437
N. Y. & N. E.....	13,382	113,470
N. Y., N. H. & H.....	98,573	183,492
N. Y., Providence & Boston.....	38,802	68,915
	\$ 154,501	\$403,314

1888-1890=Ties, 261 per cent of cost of rails.

WISCONSIN GROUP.

NAME OF ROAD.	JUNE, 1879.		JUNE, 1890.	
	RAILS.	TIES.	RAILS.	TIES.
Chi., M. & St. Paul.....	\$345,106	\$152,477	\$274,918	\$632,547
Chicago & N.-W.....	339,321	184,394	205,358	500,131
*C. St. P., M. & Omaha.....	.....	.....	239,845	198,493
*C. S. S. & Atlantic.....	.....	.....	16,342	18,194
Green Bay, W. & St. P.....	.....	.....	10,722	11,299
*Mil. & Northern.....	26,936	12,255	7,017	14,950
*M. Lake Shore & M.....	.....	.....	55,268	60,561
*Northern Pacific.....	.....	.....	104,440	662,872
*Wisconsin Central.....	.....	.....	26,584	68,220
	\$711,363	\$349,126	\$940,494	\$2,167,267

1879=Ties, 49 per cent. of the cost of rails.

1890=Ties, 230 per cent. of the cost of rails.

*Rails and ties included in Railway and Track account in 1879 report.

KANSAS GROUP.

Average for two years ending September 30, 1889.

NAME OF ROAD.	RAILS.	TIES.
A., T. & Santa Fe.....	\$103,944	\$287,025
C., R. I. & P.....	159,691	274,064
C., K. & Neb.....	.....	.....
K. C., Ft. S. & M.....	45,546	93,133
Mo. Pac. & Cent. Branch.....	131,254	279,196
M., K. & F.....	118,454	266,386
St. L. & San Francisco.....	31,032	105,370
U. P.....	170,341	363,750
O. M. & Rep. Valley.....	33,097	40,203
St. Joe & Grand Island.....	863	46,123
	\$794,222	\$1,755,250

1889=Ties, 222 per cent. the cost of rails.

THE
Servis Tie Plates



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The Q.&C. COMPANY

705 PHENIX BUILDING,

CHICAGO, = ILLINOIS.

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